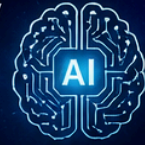




THE FUTURE OF AI IN CARDIOLOGY

Precision Cardiovascular Medicine with Big Data and AI

Insights from Nature, 2026 – Shaping the Next Era of Cardiovascular Care

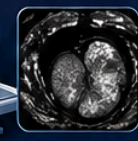
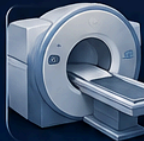


1. CARDIAC IMAGING – AI ENHANCING DIAGNOSIS



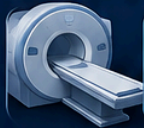
FFR-CT (Preprocedural)

- Commercialized by Heartflow
- Used in >250,000 patients
- 3D model from CT angiogram simulates blood flow to determine if cath lab is needed
- Actively used in US hospitals



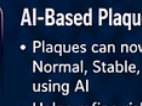
CMR (LIBRE)

- No longer requires breath-holding
- Produces high-resolution images of coronary arteries
- Improves patient comfort and image quality



Coronary CT Angiography

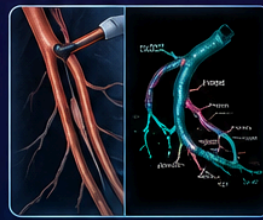
- Now Class 1 (Strongly Recommended) and Level A (High-quality evidence) according to ACC/AHA



AI-Based Plaque Characterization

- Plaques can now be qualified as Normal, Stable, or Vulnerable using AI
- Helps refine risk stratification and treatment planning

2. THERAPEUTIC DECISION MAKING IN THE CATH LAB



QFR (Quantitative Flow Ratio)

- Similar to FFR but done in-procedure while catheter is in the vessel
- Creates 3D model to assess functional significance
- Helps decide whether to stent or not
- FDA cleared
- Used in cath labs in Europe and some in US (not yet widely used)
- FFR remains the gold standard

3. RESEARCH & PROSPECTS – AI TRANSFORMING CARE

A. CORONARY ARTERY DISEASE



Revascularization Decision Making

- ML study: complex triple vessel disease in younger patients may benefit more from PCI over CABG
- 2025 study (n >40,000): AI suggestions in revascularization could improve outcomes by 32%
- ChatGPT-like models used in decision simulation show moderate concordance with real-world experts in multivessel CAD management



Antiplatelet Therapy Optimization

- AI-DAPT model predicts clot, MI and bleeding risks over 36 months post-PCI
- Continuously updates risk profile with new patient data to suggest optimal DAPT duration
- Genetic profiling for DAPT metabolism can further personalize therapy

B. HEART FAILURE



AI + Wearables Predict low EF & HF

- LINK-HF multi-sensor patch, adaptive servo-ventilation devices detect hypopnea
- Mayo Clinic AI model detects asymptomatic LVEF \leq 35% from standard ECGs – higher risk of future ventricular dysfunction



AI-Echo for Diagnosis

- EchoNet-Dynamic, DROID models read echos at expert level
- EchoGo HF v2 diagnoses & risk stratifies HFpEF more accurately than HFA-PEFF and H2FPEF scores



Phenotyping & Personalized Therapy

- AI groups HF patients by physical, molecular & clinical phenotypes
- Identifies which phenotypes respond better to specific medications and predicts side effects

IMPACT ACROSS THE CARDIOVASCULAR CARE CONTINUUM



C. ATRIAL FIBRILLATION



Screening & Continuous Monitoring (Current Use)

- Wearables (smartwatches) use PPG \pm single-lead ECG to detect rhythm abnormalities early
- Mayo Clinic AI-ECG identified subclinical AF from 10-sec sinus-rhythm ECG



AF Prediction (Future)

- Predict AF episodes before they occur using R-R intervals
- Estimate time to AF onset



AF Detection in Special Populations

- German AI model predicts 7-day post-stroke AF from age + 1-hr continuous ECG
- Other studies detect latent AF in stroke patients that may have caused the event



Clinical Decision Support

- Predict thrombotic & bleeding risks in ablation patients to guide anticoagulation
- Reminds clinicians to prescribe anticoagulants, identifies reasons for omission & improves adherence



AF Ablation Planning

- AI helps locate AF drivers beyond pulmonary veins
- Predicts recurrence risk based on cardiac structure & biomarker patterns

D. HYPERTENSION



Innovative Diagnosis

- AI uses retinal vessel visualization, retinal microcirculation & even pharyngeal images
- Detects secondary hypertension from labs, notes & EHR patterns with ~92% accuracy



Early Risk Prediction

- Predicts hypertension risk 1–2 years before onset based on trends over time
- Combines genetic risk with ML to predict BP ranges



Subtyping for Personalization

- Model groups >40,000 people into 5 subtypes based on age, comorbidities, BMI & social determinants
- Paves way for personalized treatment strategies



AI-Integrated Wearables

- Sensor patches & smartwatches enable remote BP monitoring
- Supports shift to remote tele-monitoring in cardiology
- Currently limited by calibration, motion artifacts & individual differences



Treatment Personalization

- AI predicts drug response in certain studies
- Remote monitoring & feedback enhance adherence & patient self-efficacy

THE ROAD AHEAD

- AI will enable earlier detection, precision diagnosis, and personalized therapy across all CV diseases
- Integration of multimodal data (imaging, genomics, wearables, EHR) will drive smarter, proactive care
- Human-AI collaboration is key to safer, more effective cardiovascular medicine



CHALLENGES TO ADDRESS



Data Privacy & Security



Bias & Equity in AI Models



Validation & Regulatory Pathways



Clinical Integration & Trust

“AI will not replace cardiologists, but cardiologists who use AI will lead the future.”



CURRENT ROLE OF

AI IN CARDIOLOGY



LLMS (LARGE LANGUAGE MODELS)

- Highly used by patients for symptoms as well as general search management.
- Used by clinicians for documentation, investigation, and education, mostly used as supplementary tools for practitioners, enhancing diagnostic accuracy and decision-making.



EXAMPLE: LLMS WITH ECG

An article published by Sage Health used chatbots for ECG interpretation compared to clinical cardiologists. Demonstrated that GPT-based ECG models (ECGInterpreter and ECG-Reader)

- Growing accuracy on integration (50-75%)
- Knowledge comprehensible to early-year residents
- Performance improvement with added clinical context and structured prompts



SO WHAT'S THE PANORAMA?

Currently, LLMs, even if not as clinically precise as a board-licensed physician, can still accurately diagnose and interpret medically significant data to provide guidance as a tool for both treatments and diagnostics.



ADVANCED IMAGING



- AI that guides the physician in real time to obtain correct images.
- Automate measurements such as ejection fraction.
- It enables non-expert physicians to perform ultrasounds correctly.



DIAGNOSTICS AND PREVENTION



- Highly portable 12-lead resting ECG system that detects different arrhythmias and morphologies
- Requires minimal, self-guided training.
- single-cable design makes lead placement more intuitive and less error-prone
- device communicates with an app on a smartphone, often via ultrasound or Bluetooth, to display the EKG in real-time on the phone screen.



AI-POWERED CARE COORDINATION PLATFORMS



- Optimizing call to action time → team notification time → door to intervention
- Real time data sharing between departments
- Predict hospital readmission, fewer unnecessary tests and hospitalizations
- AI assisted clinical notes and summaries
- Capable of analyzing large amounts of data for better patient experience and adherence



AI-POWERED STETHOSCOPES



- Detects heart murmurs, atrial fibrillation, and other anomalies in real time.
- Uses algorithms trained with millions of heart sounds
- Sensitivity >90% for detecting murmurs



AI is transforming cardiology by enhancing diagnostics, streamlining workflows, enabling early detection, and improving patient outcomes through data-driven, more personalized, and efficient care.



PRESENTATION BY :

- AJALA GLORIA, (NIGERIA)
- DIEGO GÓMEZ DE LA GARZ , (MEXICO)
- JOSE MIGUEL SOTO DÁVILA, (MEXICO)

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